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Perspective

Vaping and the Redefinition of Nicotine Exposure: A Multisector Priority for Contemporary Public Health

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Abstract

The rapid expansion of electronic cigarette use represents a fundamental shift in global nicotine exposure, extending beyond its original framing as a harm-reduction tool for smokers. Emerging evidence indicates that vaping constitutes a distinct toxicological and behavioral exposure, characterized by aerosolized nicotine, solvents, metals, and flavoring compounds with potential respiratory, cardiovascular, immunological, and neurobiological effects. Of particular concern is the disproportionate uptake among adolescents and young adults, many of whom have no prior history of combustible tobacco use, raising implications for long-term dependence and neurodevelopmental vulnerability. Current evidence remains limited by device heterogeneity and short follow-up durations, underscoring the need for standardized research frameworks. This perspective synthesizes existing evidence, highlights key research gaps, and outlines clinical and policy priorities required to address vaping as an evolving public health challenge.

Keywords: *Electronic cigarettes, Vaping, Nicotine exposure, Adolescent health, Public health policy*

The rapid global expansion of electronic cigarette use marks a pivotal transformation in nicotine consumption patterns, one that carries implications far beyond its initial positioning as a harm-reduction tool.[1] Over the past decade, vaping has transitioned from a niche innovation designed for smokers seeking alternatives to combustion-based tobacco to a widespread behavioral trend, particularly among adolescents and young adults who previously exhibited declining rates of nicotine use.[2] This rise, occurring in the absence of mature regulatory frameworks and amidst persistent gaps in long-term safety evidence, necessitates a coordinated, evidence-driven response from the scientific, clinical, and policy communities.

Understanding vaping as a distinct exposure is essential, as its toxicological and behavioral profile diverges significantly from that of traditional cigarettes. Although the absence of combustion eliminates certain harmful by-products, aerosolized nicotine, propylene glycol, glycerol, heavy metals, and flavoring compounds create a complex mixture with its own spectrum of biological effects.[3-5] Early peer-reviewed studies indicate associations with respiratory inflammation, endothelial dysfunction, oxidative stress, immune modulation, and potential neurobiological impact for early-age users.[6,7] These findings, while still emerging, challenge narratives that simplistically categorize vaping as inherently "safer," emphasizing instead that it represents a different risk, one that remains incompletely understood.

The limitations in current evidence underscore the need for sustained, methodologically rigorous research programs. Longitudinal cohort studies capable of evaluating chronic outcomes are still few, in part due to the relative novelty of high-nicotine salt devices and disposable high-capacity systems. In vitro and in vivo toxicology studies often vary in methodology, particularly regarding puffing protocols and aerosol composition, complicating comparative interpretation. Device heterogeneity, ranging from low-wattage pod systems to refillable tank-based models, further adds to the complexity, as temperature, voltage, coil material, and e-liquid formulation substantially influence toxicant generation. Establishing standardized analytic frameworks, harmonizing exposure metrics, and developing biomarkers of injury will be critical to generating reproducible, policy-relevant evidence.

Beyond physiological impacts, the demographic redistribution of nicotine exposure represents one of the most pressing public health concerns associated with vaping. Surveys across multiple regions document substantial uptake among adolescents, many of whom report no prior history of combustible tobacco use. Flavored products, discreet design features, social-media–driven normalization, and misperceptions of minimal harm have contributed to a rapid increase in experimentation and regular use within this age group. Neurodevelopmental susceptibility during adolescence heightens vulnerability to nicotine dependence and may influence cognitive and emotional regulation, raising concerns about long-term behavioral trajectories.[8] If unaddressed, this shift risks entrenching a new generation of nicotine-dependent individuals, reversing decades of progress in tobacco control.

A comprehensive response must integrate the efforts of clinicians, researchers, policymakers, educators, and public health authorities. Clinicians remain the primary interface for early detection of vaping behaviors.

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Incorporating routine screening into adolescent and young adult consultations, delivering evidence-based counselling, and addressing misconceptions regarding safety are essential steps toward mitigation. Clinical training programs must evolve to include updated guidance on identifying vaping-related symptoms, managing nicotine dependence in the context of novel delivery systems, and counseling patients who may be unaware of evolving scientific evidence.

Researchers hold a central role in clarifying unanswered questions. Priority areas include chronic disease risk quantification, cardiovascular and pulmonary outcome trajectories, toxicant-specific biomarkers, endocrine and neurocognitive effects of early exposure, and the influence of device characteristics on harm potential. Interdisciplinary work, linking toxicology, behavioral science, epidemiology, and regulatory science, will be necessary to capture the full scope of vaping's impact.

Policy actors must strengthen regulatory frameworks that remain fragmented or outdated. Areas requiring immediate attention include youth access restrictions, advertising regulations, limits on flavor availability, mandatory disclosure of device specifications and e-liquid contents, and oversight of nicotine concentration thresholds. Regulation should also consider the rapid pace of technological innovation, ensuring adaptability to emerging formulations and market trends. Effective policy must balance harm-reduction potential for established smokers with firm strategies to prevent initiation among younger populations.

Surveillance infrastructure must evolve in parallel with these policy efforts. Traditional tobacco surveillance systems are often insufficient for tracking the rapidly diversifying vaping landscape. Comprehensive monitoring should include device availability, product modification trends, usage frequency, dual-use patterns, and demographic disparities. Integrating toxicological surveillance, tracking levels of specific aerosol constituents and biomarkers of exposure, would allow for earlier detection of emerging risks and timely regulatory intervention. Collaborative international data systems may be required as product markets and supply chains increasingly transcend national borders.

Public communication strategies must also be strengthened to prevent misinformation from undermining health initiatives. Mixed messaging, often arising from premature claims of safety or unbalanced comparisons with traditional smoking, has contributed to confusion among consumers and even clinicians. Clear, evidence-aligned communication must emphasize that vaping is not a benign behavior, acknowledge the limitations of current research, and present risk in a manner that is proportionate, transparent, and scientifically grounded. Effective communication will be especially important for adolescents and parents, who frequently encounter conflicting narratives across social platforms.

In parallel, the potential role of vaping in smoking cessation requires nuanced consideration. Certain adult smokers may benefit from transitioning to less hazardous nicotine delivery systems as part of structured cessation frameworks. However, such approaches must be supported by clinical supervision, standardized product quality, and regulatory safeguards that prevent misuse, diversion, or uptake by non-smokers. The absence of such safeguards risks diluting legitimate harm-reduction strategies by enabling wide-scale recreational use.

The evolving evidence base positions vaping as neither a marginal issue nor a resolved debate, but rather as an emerging public health priority requiring sustained attention. The technology's adaptability, the shifting demographic of users, and the incomplete understanding of long-term physiological consequences collectively reinforce the need for ongoing investment in research, surveillance, and policy development. Neglecting these responsibilities risks allowing preventable harms to manifest only after widespread adoption has already occurred.

As vaping continues to redefine patterns of nicotine exposure, a forward-looking, interdisciplinary approach will be essential. Through coordinated action, anchored in scientific rigor, clinical responsibility, and adaptive policy, health systems can better anticipate risks, safeguard vulnerable populations, and ensure that decisions about nicotine use are guided by evidence rather than commercial momentum.

References:

1. Feeney S, Rossetti V, Terrien J. E-Cigarettes-a review of the evidence-harm versus harm reduction. Tob Use Insights. 2022 Mar 29;15:1179173X221087524. doi: 10.1177/1179173X221087524
2. Sanford BT, Brownstein NC, Baker NL, Palmer AM, Smith TT, Rojewski AM, Toll BA. Shift From Smoking Cigarettes to Vaping Nicotine in Young Adults. JAMA Intern Med. 2024 Jan 1;184(1):106-108. doi: 10.1001/jamainternmed.2023.5239
3. Li L, Lee ES, Nguyen C, Zhu Y. Effects of propylene glycol, vegetable glycerin, and nicotine on emissions and dynamics of electronic cigarette aerosols. Aerosol Sci Technol. 2020;54(11):1270-1281. doi: 10.1080/02786826.2020.1771270
4. Margham J, McAdam K, Cunningham A, Porter A, Fiebelkorn S, Mariner D, et al. The Chemical Complexity of e-Cigarette Aerosols Compared With the Smoke From a Tobacco Burning Cigarette. Front Chem. 2021 Sep 30;9:743060. doi: 10.3389/fchem.2021.743060
5. Khurana K, Dongre S, Awasthi S, Dashottar M, Chaware M & Katariya K. Potential link between vaping and hypothyroidism: A case report. WJBPHS. 2024 November; 20(03), 395–397. doi: 10.30574/wjbphs.2024.20.2.0892
6. Chatterjee S, Tao JQ, Johncola A, Guo W, Caporale A, Langham MC, Wehrli FW. Acute exposure to e-cigarettes causes inflammation and pulmonary endothelial oxidative stress in nonsmoking, healthy young subjects. Am J Physiol Lung Cell Mol Physiol. 2019 Aug 1;317(2):L155-L166. doi: 10.1152/ajplung.00110.2019
7. Zima K, Bogucka A, Wojtas M, Zabielska-Kaczorowska M. Immunological Effects of Electronic Cigarette Use: A Review of Current Evidence. Clin Rev Allergy Immunol. 2025 Feb 1;68(1):9. doi: 10.1007/s12016-025-09026-5
8. Reynolds LM, Faure P, Barik J. Adolescent nicotine exposure and persistent neurocircuitry changes: unveiling lifelong psychiatric risks. Mol Psychiatry. 2025 Nov;30(11):5534-5545. doi: 10.1038/s41380-025-03110-0

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